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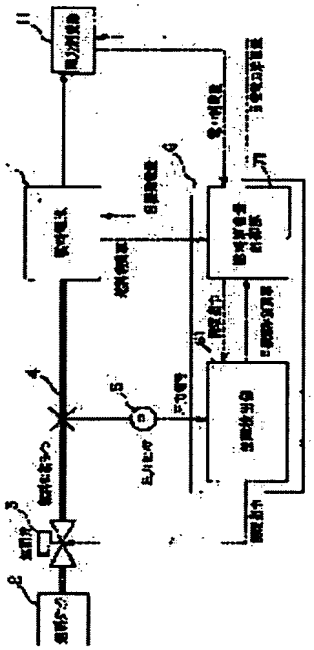
(71)Applicant : NISSAN MOTOR CO LTD
(72)Inventor : INO TAKASHI
MURAMOTO ITSURO
FUSE TORU

(54) GAS FUEL SUPPLY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a gas fuel supply device allowing failure diagnosis of a shut-off valve in a short time.
SOLUTION: A fuel is supplied from a fuel tank 2 to a fuel cell 1 via fuel supply line 4 having the shut-off valve 3 and a pressure sensor 5 in sequence, the shut-off valve 3 is opened in accordance with a failure diagnosis signal and a percentage of pressure drop is calculated in accordance with pressure information from the pressure sensor 5 and the passage of time to determine the condition of a failure of the shut-off valve 3. In this case, an electric power consuming part 11 consumes electric power generated by the fuel cell 1 to increase a target percentage of fuel consumption C1, thus permitting determination of the condition of the failure in a short time.



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CLAIMS

[Claim(s)]
[Claim 1] The fuel supply line which supplies a fuel to a fuel consumption means from a fuel-supply means, and has a latching valve and a pressure sensor, Based on a troubleshooting signal, close said latching valve, compute the rate of a pressure drop based on the pressure information and elapsed time from said pressure sensor at least, and when said rate of a pressure drop is smaller than the rate threshold of a pressure drop defined beforehand In the fuel gas feeder which has a fault detection means to judge that said latching valve is a failed state, under the conditions on which said fault detection means operates based on said troubleshooting signal The fuel gas feeder characterized by having the fuel consumption control means which increase-izes target specific fuel consumption which said fuel consumption means consumes, and controls it.
[Claim 2] The fuel gas feeder according to claim 1 characterized by having a conservation-of-energy means to conserve the energy obtained with the fuel consumed at the time of activation of troubleshooting of a latching valve in addition to said fuel consumption means.
[Claim 3] Said conservation-of-energy means is a fuel gas feeder according to claim 2 characterized by adjusting the amount of conservation of energy before troubleshooting of a latching valve.
[Claim 4] said fuel-supply means -- hydrogen -- the fuel gas feeder of any one publication of claim 1 characterized by being the hydrogen tank which stores rich fuel gas, for said fuel consumption means being a fuel cell, and said conservation-of-energy means being a stationary-energy-storage means thru/or claim 3.
[Claim 5] Said fault detection means is a fuel gas feeder according to claim 4 characterized by adjusting the charge condition of said stationary-energy-storage means according to the generated output computed from the amount of hydrogen which a diagnosis takes.
[Claim 6] It is the fuel gas feeder [claim 7] according to claim 1 characterized by for said fuel consumption means equipping juxtaposition with an auxiliary fuel consumption means, and equipping said fuel supply line with the fuel-supply rate control means which controls the rate which supplies a fuel to said fuel consumption means and said auxiliary fuel consumption means. Said auxiliary fuel consumption means is a fuel gas feeder according to claim 6 characterized by constituting from a combustor.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates the failed state of a latching valve to a diagnosable fuel gas feeder.
[0002]
[Description of the Prior Art] In order to diagnose the failed state of a latching valve from the former, a latching valve and a pressure sensor are arranged for piping between a fuel tank and fuel consumption equipments, such as an engine, at this order, and what closes a latching valve and performs troubleshooting of a latching valve with the pressure after predetermined time is known, for example, it is indicated by JP,2000-274311,A.
[0003] This measures elapsed time until it closes a latching valve and the amount of pressure drops after predetermined time or a pressure declines to a predetermined pressure during a halt of a car or operation, computes the rate of a pressure drop, and performs troubleshooting of a latching valve as compared with the rate threshold of a pressure drop.
[0004]
[Problem(s) to be Solved by the Invention] By the way, the fall rate of the pressure of a latching valve lower stream of a river changes according to the operational status of a car, i.e., the specific fuel consumption of fuel consumption equipment.
[0005] However, in the above-mentioned conventional example, a latching valve is closed, the time amount which passes although the amount of pressure drops after predetermined time or a pressure declines to a predetermined pressure is measured, and troubleshooting of a latching valve is performed. For this reason, it was what requires time amount for the fall of a pressure according to the operational status of a car when specific fuel consumption is low.
[0006] When diagnosing with the amount of pressure drops after predetermined time, the amount of lower-limit pressure force falls is determined from the detection precision and resolution of a pressure sensor, and the predetermined time to set up has the trouble that performing troubleshooting will take time amount in order to have to carry out only the amount of lower-limit pressure force falls beyond the time amount to which a pressure falls.
[0007] Moreover, since a predetermined pressure must make it below into the value which subtracted the above-mentioned amount of lower-limit pressure force falls from the fuel-tank-pressure force when measuring the time amount which passes although it falls to a predetermined pressure, when specific fuel consumption is low, there is a trouble that that a pressure declines to a predetermined pressure taking time amount, and performing troubleshooting will take time amount.
[0008] Then, this invention was made in view of the above-mentioned trouble, and aims at offering the fuel gas feeder which can be carried out in a short time for troubleshooting of a latching valve.
[0009]
[Means for Solving the Problem] The fuel supply line which the 1st invention supplies a fuel to a fuel consumption means from a fuel-supply means, and has a latching valve and a pressure sensor, Based on

a troubleshooting signal, close said latching valve, compute the rate of a pressure drop based on the pressure information and elapsed time from said pressure sensor at least, and when said rate of a pressure drop is smaller than the rate threshold of a pressure drop defined beforehand In the fuel gas feeder which has a fault detection means to judge that said latching valve is a failed state, under the conditions on which said fault detection means operates based on said troubleshooting signal It is characterized by having the fuel consumption control means which increase-izes target specific fuel consumption which said fuel consumption means consumes, and controls it.

[0010] Said fuel consumption means is a combustor which burns the fuel cell which consumes fuel gas in a fuel cell powered vehicle, and fuel gas, and said fuel consumption control means increase-izes target specific fuel consumption of these fuel cells and combustors under the conditions on which a fault detection means operates, and is controlled.

[0011] 2nd invention is characterized by having a conservation-of-energy means to conserve the energy obtained with the fuel consumed at the time of activation of troubleshooting of a latching valve in addition to said fuel consumption means in the 1st invention.

[0012] 3rd invention is characterized by said conservation-of-energy means adjusting the amount of conservation of energy before troubleshooting of a latching valve in the 2nd invention.

[0013] the 4th invention -- the 1st thru/or the 3rd invention -- setting -- said fuel-supply means -- hydrogen -- it is the hydrogen tank which stores rich fuel gas, and said fuel consumption means is a fuel cell, and said conservation-of-energy means is characterized by being a stationary-energy-storage means.

[0014] It is characterized by the 5th invention adjusting the charge condition of said stationary-energy-storage means in the 4th invention according to the generated output computed from the amount of hydrogen which a diagnosis takes said fault detection means.

[0015] In the 6th invention, in the 1st invention, said fuel consumption means equips juxtaposition with an auxiliary fuel consumption means, and said fuel supply line is characterized by having the fuel-supply rate control means which controls the rate which supplies a fuel to said fuel consumption means and said auxiliary fuel consumption means.

[0016] 7th invention is characterized by constituting said auxiliary fuel consumption means from a combustor in the 6th invention.

[0017]

[Effect of the Invention] Therefore, since a fault detection means increase-izes fuel consumption of a fuel consumption means and can control it by 1st invention, in case troubleshooting of a latching valve is carried out, by adjusting the fuel consumption of a fuel consumption means, the pressure of a fuel supply line can be lowered more in a short time, and troubleshooting of a latching valve can be performed more in a short time.

[0018] By 2nd invention, since the energy obtained too much for troubleshooting of a latching valve is stored in a conservation-of-energy means in addition to the 1st effect of the invention, troubleshooting can be performed by shorter time amount, without making a fuel useless.

[0019] In the 3rd invention, since the conservative quantity of said conservation-of-energy means is adjusted before troubleshooting of a latching valve in addition to the 2nd effect of the invention, according to the energy obtained by troubleshooting, the conservative quantity of a conservation-of-energy means is lowered, the excessive energy obtained by troubleshooting can be stored in a conservation-of-energy means, and troubleshooting is possible, without throwing away energy vainly.

[0020] In the 4th invention, since the generated output of the fuel cell which consumes hydrogen fuel gas at the time of troubleshooting of a latching valve is saved for a stationary-energy-storage means in addition to the 1st thru/or the 3rd effect of the invention, troubleshooting of a latching valve can be performed, without making hydrogen useless.

[0021] In the 5th invention, since the charge condition of said stationary-energy-storage means is adjusted according to the generated output computed from the amount of hydrogen which a diagnosis takes in addition to the 4th effect of the invention, a stationary-energy-storage means can be charged, without making useless power generated by troubleshooting.

[0022] Since the rate that a fuel-supply rate control means supplies a fuel to a fuel consumption means and an auxiliary fuel consumption means according to target specific fuel consumption and the specific fuel consumption of a fuel consumption means is controlled by 6th invention in addition to the 1st effect of the invention, when enough and the specific fuel consumption of a fuel consumption means supplies a fuel to an auxiliary fuel consumption means to target specific fuel consumption, a fuel can be consumed with target specific fuel consumption.
[0023] In 7th invention, since the combustor constituted the auxiliary fuel consumption means in addition to the 6th effect of the invention, and a combustor consumes fuel gas by the fuel-supply rate control means when a fuel consumption means cannot fully consume fuel gas or, even when a fuel consumption means cannot fully consume hydrogen, a fuel can be consumed with target specific fuel consumption.
[0024]
[Embodiment of the Invention] Hereafter, the gestalt of the operation which realizes the fuel gas feeder in this invention is explained based on the 1st operation gestalt corresponding to claim 1.
[0025] (1st operation gestalt) Drawing 1 - drawing 4 show an example of the fuel gas feeder concerning the 1st operation gestalt of this invention, and, as for a system configuration Fig., drawing 2 - drawing 4 , drawing 1 shows the control flow chart of troubleshooting. In addition, the fuel cell and fuel gas feeder which are explained below are equipment carried in mobiles, such as a fuel cell powered vehicle.
[0026] The fuel tank 2 as a fuel-supply means, as for the fuel gas feeder, to mainly fill up with the hydrogen storing metal alloy in drawing 1 , The fuel gas from a fuel tank 2, and the fuel cell 1 as a fuel consumption means to generate power by the electrochemical reaction in response to supply of oxidant gas, It has the power consumption sections 11, such as a motor inverter with which the power of a fuel cell 1 is supplied, and the controller [fuel cell / 1] 6 aiming at insurance, operating efficiently, etc.
[0027] Said fuel tank 2 stores the hydrogen which carried out occlusion to the hydrogen storing metal alloy as fuel gas. The fuel gas from a fuel tank 2 can be supplied to a fuel cell 1 via the fuel supply line 4 which consists of a latching valve 3 and piping with an antisuckback function, and controls the amount of supply by closing motion of a latching valve 3.
[0028] A controller 6 is equipped with the fuel consumption control section 71 as a fuel consumption control means, and the fault detection section 61 as a fault detection means. The fuel consumption control section 71 calculates the amount of target generations of electrical energy of a fuel cell 1 based on the power consumption consumed by the power consumption section 11 at the time of usual operation of a fuel cell 1, calculates the specific fuel consumption of a fuel cell 1, outputs the bulb opening (a close by-pass bulb completely or full open) of the required latching valve 3 to the fault detection section 61, and carries out switching operation of the latching valve 3. From the specific fuel consumption of the fuel cell 1 inputted again from the target specific fuel consumption C1 specified from the fault detection section 61, and a fuel cell 1 at the time of troubleshooting, the fuel consumption control section 71 computes the amount of target generations of electrical energy, outputs it to a fuel cell 1, and outputs target power consumption to the power consumption section 11.
[0029] The pressure signal from the pressure sensor 5 which detects the pressure in piping of the down-stream fuel supply line 4 rather than a latching valve 3 is inputted into the fault detection section 61. The fault detection section 61 carries out closing motion control of the latching valve 3 according to the opening signal from said fuel consumption control section 71 at the time of usual operation of a fuel cell 1. in addition, the regulator valve which is not illustrated at the time of usual operation of a fuel cell -- the amount of supply -- being continuous (linear) -- it is controlled. The fault detection section 61 carries out a calculation setup of the target fuel consumption C1, predetermined time t0, and the pressure drop threshold a0, and is made to control them again at the time of troubleshooting, so that it outputs to the fuel consumption control section 71 and actuation of a fuel cell 1 and the power consumption section 11 serves as the target fuel consumption C1. Moreover, a latching valve 3 is closed and failure of a latching valve 3 is judged with the pressure signal from the pressure sensor 5 after clausilium.
[0030] Next, the detailed procedure of troubleshooting [like] is explained based on the flow chart of drawing 2 - drawing 4 the 1st operative condition. Steps 300-380 steps 220-240 steps 100-150 shown in

drawing 2 indicate the conditioning of troubleshooting to be to drawing 3 indicate actuation of the fuel consumption control section 71 to be to drawing 4 show actuation of troubleshooting, respectively.
[0031] First, the conditioning of troubleshooting is step 100 and judges whether the troubleshooting signal was taken out to the fault detection section 61. It waits until return and a troubleshooting signal are taken out by step 100, if not taken out. If the troubleshooting signal is taken out, it will progress to step 110.
[0032] At step 110, the target specific fuel consumption C1 is set up, and it progresses to step 120. If the target specific fuel consumption C1 sets specific fuel consumption of the conventional fuel cell 1 to C0 as shown in drawing 5 , the time amount which passes in order to consume the regular amount n of hydrogen will serve as tlong. By this invention, the regular amount n of hydrogen can be consumed by the time amount t0 shorter than tlong by setting specific fuel consumption as the larger target specific fuel consumption C1 than C0 so that the time amount for consuming the amount n of hydrogen may become shorter. Therefore, target specific fuel consumption is set as C1.
[0033] The regular amount n of hydrogen is the amount of hydrogen which must be consumed since the detection value of a pressure sensor 5 is set to P1 from P0. Namely, set the volume of the fuel supply line 4 from a latching valve 3 to a fuel cell 1 to Vpipe, and if the amount of hydrogen in case a pressure is an initial pressure P0 about the absolute temperature of fuel gas and n0 in a gas constant and T, and n1 are made into the amount of hydrogen in case a pressure is P1, R The amount n of hydrogen which must be consumed since it becomes P0, Vpipe=n0, R-TP1, Vpipe=n1, and R-T is n=n0-n1=(1-P1/P0) n0=(1-P1/P0) P0 and Vpipe/(R-T).
= P0-P1Vpipe/(R-T)
It becomes.
[0034] What is necessary is here, just to set up the amount of pressure drops (P0-P1) more than differential pressure **P, since, as for amount of pressure drops (P0-P1) =deltaP, differential pressure **P identifiable enough is determined by the pressure sensor 5 from the detection range and resolution of a pressure sensor 5.
[0035] At step 120, predetermined time t0 is set up and it progresses to step 130. Predetermined time t0 is equivalent to the consumption time amount when consuming said amount n of hydrogen with the target specific fuel consumption C1. That is, if specific fuel consumption C1 is determined, the amount of hydrogen consumed with specific fuel consumption C1 will serve as time amount used as Vpipe(P0-P1)/(R-T). Drawing 6 shows the pressure and the relation of time amount which are detected from the pressure sensor 5 from the time of a latching valve 3 closing. a time -- 0 -- the rate a1 of a pressure drop is computed from the amount of pressure drops (P0-P1) until the predetermined time t0 which outputted the closed command at the latching valve 3, and was sometimes defined beforehand passes.
[0036] At step 130, the rate threshold a0 of a pressure drop is set up, and it progresses to step 140. From the target specific fuel consumption C1, the rate threshold a0 of a pressure drop can compute the rate of a theoretical pressure drop when a latching valve 3 closes completely, and if the latching valve 3 is not out of order, it will compute the rate threshold a0 of a pressure drop in consideration of the width of face of the rate of a pressure drop which can be judged. In addition, the rate threshold a0 of a pressure drop may be computed by experimenting using the broken latching valve 3 and measuring the rate of a pressure drop at the time of failure. Thus, the fault detection section 61 computes the above-mentioned target specific fuel consumption C1, and outputs it to the fuel consumption control section 71.
[0037] At step 140, the amount of target generations of electrical energy is set up by the fuel consumption control section 71, and it progresses to step 150. The amount of target generations of electrical energy is computed from the specific fuel consumption of the fuel cell 1 inputted from the target specific fuel consumption C1 inputted from the fault detection means 61, and a fuel cell 1.
[0038] At step 150, the target power consumption which makes the amount of generations of electrical energy generated with a fuel cell 1 consume in the power consumption section 11 is set up, and it progresses to step 220 of the flow chart of the fuel consumption control section 71 of drawing 3 .
[0039] At step 220 which starts actuation of the fuel consumption control section 71, the amount of target generations of electrical energy is adjusted, and it outputs to a fuel cell 1 so that a fuel cell 1 may

consume hydrogen with the target specific fuel consumption C1, and it progresses to step 230.
[0040] At step 230, in order to consume the power which the fuel cell 1 generated in the power consumption section 11, target power consumption is adjusted, target power consumption is outputted to the power consumption section 11 from the fuel consumption control section 71, and it progresses to step 240.
[0041] At step 240, it judges whether the difference of the specific fuel consumption of a fuel cell 1 and the target specific fuel consumption C1 is predetermined within the limits. If it is within the limits, it will progress to step 300 of the flow chart of troubleshooting actuation of drawing 4 . If out of range, it will adjust so that steps 220-230 may be repeated and the difference of the specific fuel consumption of a fuel cell 1 and the target specific fuel consumption C1 may become predetermined within the limits.
[0042] The fault detection section 61 takes out a closed command with step 300 which starts troubleshooting actuation of drawing 4 to a latching valve 3, and it progresses to step 310 at it. drawing 6 -- a time -- 0 -- it is .
[0043] At step 310, the fuel gas pressure P0 of latching valve 3 lower stream of a river of the fuel supply line 4 is detected from a pressure sensor 5, and it progresses to step 320.
[0044] At step 320, after a closed command is issued by the latching valve 3, it judges whether predetermined time t0 passed. If it has passed, it progresses to step 330, and it will wait until predetermined time t0 passes, if it has not passed. It is t0 reference at the time of drawing 6 .
[0045] At step 330, the fuel gas pressure P1 of the fuel supply line 4 of latching valve 3 lower stream of a river after predetermined time t0 passes is detected from a pressure sensor 5, and it progresses to step 340.
[0046] At step 340, the rate a1 of a pressure drop is computed by (P0-P1) / t0, and it progresses to step 350.
[0047] At step 350, it judges whether the rate a1 of a pressure drop computed at step 340 is smaller than the rate threshold a0 of a pressure drop defined beforehand. If small, it will progress to step 360, and if not small, it progresses to step 370.
[0048] At step 360, since the rate a1 of a pressure drop was smaller than the rate threshold a0 of a pressure drop, it judges that fuel gas supplies the fuel cell 1, without a latching valve 3 intercepting fuel gas completely, a latching valve failure flag is set, and it progresses to step 380.
[0049] At step 370, since the rate a1 of a pressure drop is not smaller than the rate threshold a0 of a pressure drop, it judges that the latching valve 3 is intercepting fuel gas, and a latching valve failure flag is cleared, and it progresses to step 380.
[0050] It progresses to the failure manipulation routine which is not illustrated at step 380. When the latching valve failure flag is set, failure processing of reporting that suspended the system and it is out of order to the driver is performed, and it progresses to a degree and ends.
[0051] Thus, it becomes possible to perform troubleshooting of a latching valve 3 by shorter time amount by processing.
[0052] In addition, since he wants to bring P1 close to P0 and to enlarge it more in order to shorten diagnostic time amount t0, as for P1, it is desirable to set it as P0-**P.
[0053] If it is in the gestalt of this operation, the fuel consumption control section 71 as a fuel consumption control means In order to control the fuel consumption means 11 to consume a fuel with the target specific fuel consumption C1 computed by the fault detection section 61 as a fault detection means, In case troubleshooting of a latching valve 3 is carried out, by adjusting the fuel consumption of the fuel cell 1 as a fuel consumption means, the pressure of the fuel supply line 4 can be lowered more in a short time, and troubleshooting of a latching valve 3 can be performed more in a short time.
[0054] (The 2nd operation gestalt) The gestalt of the operation which realizes the fuel gas feeder in this invention is hereafter explained based on the 2nd operation gestalt corresponding to claims 6 and 7.
[0055] Drawing 7 - drawing 9 show an example of the fuel gas feeder concerning the 2nd operation gestalt of this invention, and are different from the 1st operation gestalt with the configuration equipped with the fuel-supply rate control section which branches and supplies to a combustor the fuel gas supplied to the combustor and fuel cell by fuel gas. As for drawing 7 , a system configuration Fig.,

drawing 2 , drawing 8 , and 9 are the control flow charts of troubleshooting.
[0056] In drawing 7 , 9 shows the combustor which burns fuel gas, shunts the fuel gas to the fuel cell 1 from the fuel supply line 4 by the fuel-supply rate control section 10, and is supplied. A combustor 9 is started by the seizing signal from the specific-fuel-consumption control section 72. As for the fuel supply line 4, the latching valve 3, the pressure sensor 5, and the fuel-supply rate control section 10 are formed in this order between the fuel tank 2 and the fuel cell 1. The fuel-supply rate control section 10 adjusts the rate of the fuel gas supplied to a fuel cell 1 and a combustor 9 according to the target fuel-supply rate command inputted from the fuel consumption control section 72. That is, the fuel consumption control section 72 outputs a target fuel-supply rate command to the fuel-supply rate control section 10, outputs the amount command of target generations of electrical energy to a fuel cell 1, outputs a seizing signal to a combustor, and outputs target power consumption to the power consumption section 11.
[0057] Next, the detailed procedure of troubleshooting [like] is explained based on drawing 2 , drawing 8 , and the flow chart of 9 the 2nd operative condition. Steps 400-490 steps 211-271 steps 100-150 shown in drawing 2 indicate the conditioning of troubleshooting to be to drawing 8 indicate actuation of the fuel consumption control section 72 to be to drawing 9 show actuation of troubleshooting, respectively.
[0058] Steps 100-150 shown in drawing 2 have already explained the conditioning of troubleshooting, and explain the order of steps 211-271 for the actuation of the fuel consumption control section 72 shown in drawing 8 later on.
[0059] At step 211 of actuation of the fuel consumption control section 72, a target fuel-supply rate is adjusted and it progresses to step 221. The initial value of a target fuel-supply rate becomes a fuel cell 1, and has become a combustor with 0% 100%. When it reaches to step 211 via step 251, a target fuel-supply rate is adjusted so that fuel consumption may be in agreement with target fuel consumption. The amount of adjustments map-izes relation between fuel consumption and a target fuel-supply rate by experiment etc. beforehand, and computes it.
[0060] At step 221, the amount of target generations of electrical energy is adjusted, and it progresses to step 231 so that a fuel cell 1 may consume hydrogen with the target specific fuel consumption C1. When the combustor 9 has started, according to the target specific fuel consumption C1 and the amount of hydrogen supplied to a fuel cell 1, the amount of target generations of electrical energy is adjusted.
[0061] At step 231, in order to consume the power which the fuel cell 1 generated in the power consumption section 11, the target power consumption in the power consumption section 11 is adjusted, and it progresses to step 241. When the combustor 9 has started, target power consumption is adjusted according to the amount of hydrogen supplied to a fuel cell 1.
[0062] At step 241, it judges whether the specific fuel consumption of a fuel cell 1 is smaller than the target specific fuel consumption C1. If small, it will progress to step 251, and if not small, it progresses to step 271.
[0063] At step 271, it judges whether the specific fuel consumption of a fuel cell 1 is larger than the target specific fuel consumption C1. If large, it will progress to step 221, and if not large, it progresses to step 400 which is actuation of troubleshooting shown in drawing 9 via B.
[0064] At step 251, a seizing signal is outputted to a combustor 9 and it progresses to step 211.
[0065] Decision of step 241 and step 271 judges by giving the suitable range for branch condition. In case specific fuel consumption C is compared with the target specific fuel consumption C1, at step 241, suitable range **C>0 is set up, and if (C1<C+**C) is materialized, it will progress to step 271, and if (C1>C-**C) is materialized, specifically by step 271, it will progress to step 400 which is actuation of troubleshooting shown in drawing 9 .
[0066] In actuation of troubleshooting shown in drawing 9 , the pressure detected from a pressure sensor 5 measures the elapsed time t1 which falls to the predetermined pressure P2 to actuation of troubleshooting of drawing 4 measuring the amount of pressure drops when predetermined time t0 passes, and carrying out troubleshooting of a latching valve 3, and troubleshooting of a latching valve 3 is performed.

[0067] Drawing 10 explains the detail of the troubleshooting approach. The thick wire of drawing 10 is drawing having shown the pressure and the relation of time amount which are detected from a pressure sensor 5. a time -- 0 -- a latching valve 3 -- a closed command -- taking out -- a pressure sensor 5 -- the elapsed time t1 until a detection value becomes the predetermined pressure P2 defined beforehand is measured. Troubleshooting of a latching valve 3 is performed by comparing time amount and elapsed time t1 until a pressure turns into the predetermined pressure P2 from P0 with the above-mentioned rate threshold a0 of a pressure drop.
[0068] Actuation of return and troubleshooting is explained to drawing 9 based on a flow chart.
[0069] At step 400, the fault detection section 61 outputs a closed command to a latching valve 3.
[0070] At step 410, measurement of the fuel gas pressure P1 which detects the fuel gas pressure P0 of the fuel supply line 4 of latching valve 3 lower stream of a river, and is detected from the pressure sensor 5 every moment is started.
[0071] At step 420, measurement of the elapsed time t1 after outputting a closed command to a latching valve 3 is started.
[0072] step 430 -- a pressure sensor 5 -- current events -- it judges whether the fuel gas pressure P1 detected every moment is smaller than the diagnostic halt pressure P2 defined beforehand. If small, it will progress to step 440, and if not small, it progresses to step 430. The time amount of the diagnostic halt pressure P2 which requires for a diagnosis the way made into the bigger value in the range identifiable enough decreases in a pressure sensor 5, and it is more effective. Therefore, the diagnostic halt pressure P2 is set up from the resolution and the detection range of the fuel gas pressure P0 of latching valve 3 lower stream of a river, and a pressure sensor 5.
[0073] since a closed command is outputted to a latching valve 3 at step 440 -- a pressure sensor 5 -- current events -- measurement of the elapsed time t1 until the fuel gas pressure P1 detected every moment is less than the diagnostic halt pressure P2 is stopped.
[0074] At step 450, the rate a2 of a pressure drop is computed from (P0-P2) / t1.
[0075] At step 460, it judges whether the rate a2 of a pressure drop computed at step 450 is smaller than the rate threshold a0 of a pressure drop defined beforehand. If small, it will progress to step 470, and if not small, it progresses to step 480.
[0076] At step 470, since the rate a2 of a pressure drop was smaller than the rate threshold a0 of a pressure drop, a latching valve 3 judges that fuel gas supplies the fuel cell 1 side, without intercepting fuel gas, and sets a latching valve failure flag.
[0077] At step 480, since the rate a2 of a pressure drop is not smaller than the rate threshold a0 of a pressure drop, a latching valve 3 judges that fuel gas is intercepted, and clears a latching valve failure flag.
[0078] It progresses to the failure manipulation routine which is not illustrated at step 490. When the latching valve failure flag is set, failure processing of reporting that suspended the system and it is out of order to the driver is performed, and it progresses to a degree and ends.
[0079] Thus, by processing, even if a fuel cell 1 cannot consume a fuel with the target specific fuel consumption C1, by using a combustor 9, it becomes possible to consume a fuel with the target specific fuel consumption C1, and it becomes possible to perform troubleshooting of a latching valve 3 more for a short time.
[0080] If it is in the gestalt of this operation, in addition to the effectiveness by the gestalt of the 1st operation, the fuel cell 1 as a fuel consumption means equips juxtaposition with the combustor 9 as an auxiliary fuel consumption means. Since the rate that the fuel-supply rate control section 10 as a fuel-supply rate control means supplies a fuel to a fuel cell 1 and a combustor 9 according to the target specific fuel consumption C1 and the specific fuel consumption of a fuel cell 1 is controlled When enough and the specific fuel consumption of a fuel cell 1 supplies a fuel to a combustor 9 to the target specific fuel consumption C1, a fuel can be consumed with the target specific fuel consumption C1.
[0081] Moreover, since the combustor 9 constituted the auxiliary fuel consumption means and a combustor 9 consumes fuel gas by the fuel-supply rate control section 10 even when a fuel cell 1 cannot fully consume fuel gas, a fuel can be consumed with the target specific fuel consumption C1.

[0082] (The 3rd operation gestalt) The gestalt of the operation which realizes the fuel gas feeder in this invention is hereafter explained based on the 3rd operation gestalt corresponding to claims 2-5.
[0083] Drawing 11 - drawing 13 show an example of the fuel gas feeder concerning the 3rd operation gestalt of this invention, and add the rechargeable battery which can charge the power generated with the fuel cell to the 1st operation gestalt. As for a system configuration Fig., drawing 12 , 13, and drawing 4 , drawing 11 shows the control flow chart of troubleshooting.
[0084] In drawing 11 , a rechargeable battery 8 can charge the power which the fuel cell 1 generated, and discharging in the power consumption section 11 is possible. The charge condition of a rechargeable battery 8 changes according to the amount of generations of electrical energy of a fuel cell 1, and the power consumption of the power consumption section 11.
[0085] The fault detection section 63 starts troubleshooting from a troubleshooting signal. Before the fault detection section 63 closes a latching valve 3, it computes the amount of power adjustments and outputs it to the fuel consumption control section 73 so that a fuel cell 1 may be in the condition that a rechargeable battery 8 can charge the power generated too much, by troubleshooting.
[0086] The target specific fuel consumption C1 and the amount of power adjustments are inputted from the fault detection section 63, specific fuel consumption is inputted from a fuel cell 1, and the fuel consumption control section 73 computes the amount of target generations of electrical energy, and target power consumption. If the amount of power adjustments changes, the balance of the amount of target generations of electrical energy and target power consumption can also change, and the charge condition of a rechargeable battery 8 can be changed.
[0087] Next, the detailed procedure of troubleshooting [like] is explained based on drawing 12 , 13, and the flow chart of drawing 4 the 2nd operative condition. Steps 300-380 steps 221-241 steps 100-195 shown in drawing 12 indicate the conditioning of troubleshooting to be to drawing 13 indicate actuation of the fuel consumption control section 73 to be to drawing 4 show actuation of troubleshooting, respectively.
[0088] The actuation which the part concerning steps 100-150 of the conditioning of troubleshooting shown in drawing 12 detects a troubleshooting start signal at step 100, sets up the target specific fuel consumption C1 at step 110, sets up predetermined time t0 at step 120, computes the rate threshold a0 of a pressure drop at step 130, sets up the amount of target generations of electrical energy at step 140, and sets up the target power consumption C1 at step 150 is the same as steps 100-150 of drawing 2 .
[0089] At step 160, the charge condition of a rechargeable battery 8 is read and it progresses to step 170.

[0090] At step 170, the amount of power adjustments is set up as follows, and it progresses to step 180. In order to carry out troubleshooting, the power generated from the amount n of hydrogen which a fuel cell 1 must consume is computed. The power used with an accessory vessel required in order to operate a fuel cell 1 from the computed power is lengthened. The target charge condition that charge of a rechargeable battery 8 of this power is attained is computed. The difference of the charge condition of the rechargeable battery 8 read at step 160 and a target charge condition is computed, and the amount of power adjustments to a rechargeable battery 8 is computed.
[0091] The first amount of target generations of electrical energy adjusted at step 180 and the first target power consumption adjusted at step 190 are adjusted so that the charge condition of a rechargeable battery 8 may be in agreement with a target charge condition. For example, the first target power consumption is set as a necessary minimum value, in order to avoid the futility of power, and the first amount of target generations of electrical energy sets up the time amount of the request to which the charge condition of a rechargeable battery 8 will be in a target charge condition, and it should just set up the first amount of target generations of electrical energy so that a charge condition may be in a target charge condition by the set-up time amount.
[0092] At step 195, it judges whether the charge condition of a rechargeable battery 8 changed into the condition that the power generated by troubleshooting can be charged. If it has become and has not come to progress to step 221 which is actuation of the fuel consumption control section 73 of drawing 13 , steps 160-190 are performed again.

[0093] At step 221 which is actuation of the fuel consumption control section 73 of drawing 13 , the second amount of target generations of electrical energy is adjusted so that a fuel cell 1 may consume hydrogen with the target specific fuel consumption C1, and it progresses to step 231.
[0094] At step 231, in order to consume the power which the fuel cell 1 generated in the power consumption section 11, target power consumption is adjusted, and it progresses to step 241.
[0095] At step 241, it judges whether the difference of the specific fuel consumption of a fuel cell 1 and the target specific fuel consumption C1 is predetermined within the limits. if it is within the limits, it will progress to step 300 via B of drawing 4 which is actuation of troubleshooting -- if out of range, it will progress to step 221 and steps 221-241 will be performed again.
[0096] Subsequently, troubleshooting processing of steps 300-380 of drawing 4 (it sets like the 1st operative condition and has already explained to a detail here) simple -- indicating -- it performs, a latching valve 3 is closed, the gas fuel pressure P1 of the fuel supply line 4 after predetermined time t0 progress is detected, and the rate a1 (= (P0-P1) / t0) of a pressure drop is computed, and as compared with the pressure drop threshold a0, troubleshooting of the latching valve 3 is carried out, and it ends.
[0097] Thus, in order to store the power which the fuel cell 1 generated in a rechargeable battery 8 in addition to consumption by the power consumption section 11, it becomes possible to perform troubleshooting of a latching valve 3 by shorter time amount. And in order to store the generated power in a rechargeable battery 8, making useless fuel gas and generated power is lost.
[0098] If it is in the gestalt of this operation, in addition to the effectiveness by the gestalt of the 1st operation, the effectiveness indicated below can be done so. That is, since the energy obtained too much because of troubleshooting of a latching valve 3 is stored in the rechargeable battery 8 as a conservation-of-energy means, troubleshooting can be performed by shorter time amount, without making a fuel useless.
[0099] Since the conservative quantity of the rechargeable battery 8 as said conservation-of-energy means is adjusted before troubleshooting of a latching valve 3, the conservative quantity of a rechargeable battery 8 is lowered according to the energy obtained by troubleshooting, the excessive energy obtained by troubleshooting can be stored in a rechargeable battery 8, and troubleshooting is possible, without throwing away energy vainly.
[0100] In addition, if it considers as drawing 2 (conditioning of troubleshooting), drawing 3 (actuation of a fuel consumption control section), and drawing 4 (troubleshooting actuation) if it is in the above-mentioned 1st operation gestalt, and it is in the 2nd operation gestalt It considers as drawing 2 (conditioning of troubleshooting), drawing 8 (actuation of a fuel consumption control section), and drawing 9 (troubleshooting actuation), and has three kinds of composition in the 3rd operation gestalt as drawing 12 (conditioning of troubleshooting), drawing 13 (actuation of a fuel consumption control section), and drawing 4 (troubleshooting actuation). However, although these combination is not limited to the above-mentioned combination and illustrated, it may be combination of drawing 12 , drawing 8 , and drawing 4 , for example. That is, if it is the combination which is started by drawing 2 or drawing 12 , progresses to any one of drawing 3 , drawing 8 , and the drawing 13 , and is ended by drawing 4 or drawing 9 , it is possible to diagnose a latching valve 3 by shorter time amount in every combination.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The system configuration Fig. of a fuel gas feeder showing 1 operation gestalt of this invention.
[Drawing 2] The control flow chart of the conditioning of troubleshooting.
[Drawing 3] The control flow chart of the fuel consumption control section of troubleshooting which similarly follows drawing 2 .
[Drawing 4] The control flow chart which shows actuation of troubleshooting which similarly follows drawing 3 .
[Drawing 5] The graph which shows the relation between target specific fuel consumption and consumption time amount.
[Drawing 6] The graph which showed the pressure and the relation of time amount which are detected from the time of a latching valve closing from the pressure sensor of troubleshooting by the amount measurement of pressure drops after predetermined time.
[Drawing 7] The system configuration Fig. of a fuel gas feeder showing the 2nd operation gestalt of this invention.
[Drawing 8] The control flow chart of the fuel consumption control section of troubleshooting following drawing 2 .
[Drawing 9] The control flow chart which shows actuation of troubleshooting which similarly follows drawing 8 .
[Drawing 10] The graph which showed the pressure and the relation of time amount which are detected from the pressure sensor of troubleshooting by the elapsed time measurement which the predetermined pressure drop took from the time of a latching valve closing.
[Drawing 11] The system configuration Fig. of a fuel gas feeder showing the 3rd operation gestalt of this invention.
[Drawing 12] The control flow chart of the conditioning of troubleshooting.
[Drawing 13] The control flow chart of the fuel consumption control section of troubleshooting following drawing 13 .
[Description of Notations]
1 Fuel Cell as a Fuel Consumption Means
2 Fuel Tank as a Fuel-Supply Means
3 Latching Valve
4 Fuel Supply Line
5 Pressure Sensor
6 Controller
8 Rechargeable Battery as Conservation-of-Energy Means and a Stationary-Energy-Storage Means
9 Combustor as an Auxiliary Fuel Consumption Means
10 Fuel-Supply Rate Control Section (Fuel-Supply Rate Control Means)
11 Power Consumption Section

61 62 Fault detection section (fault detection means)
71, 72, 73 Fuel consumption control section (fuel consumption control means)

[Translation done.]

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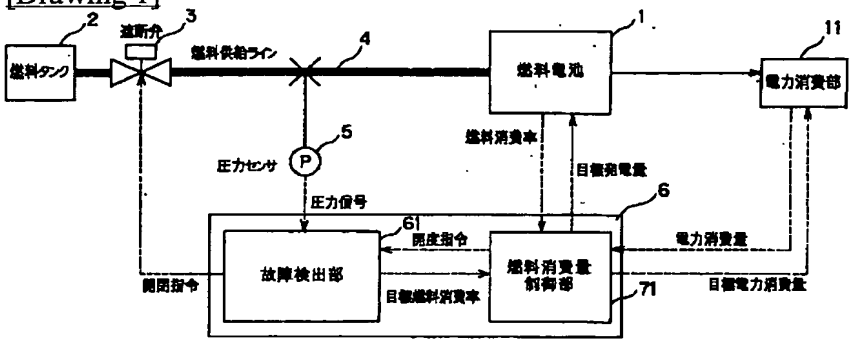
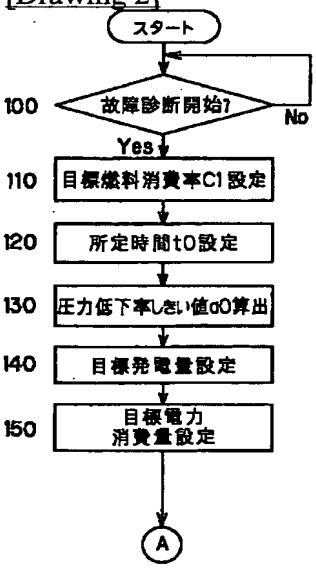
DRAWINGS

[Drawing 1]



[Drawing 2]



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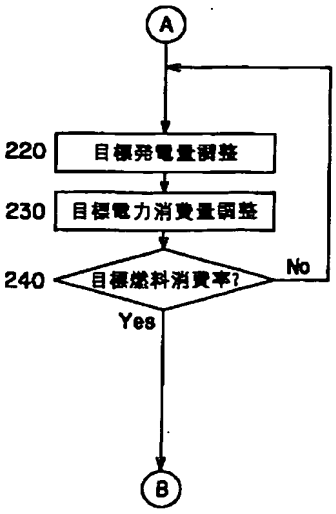

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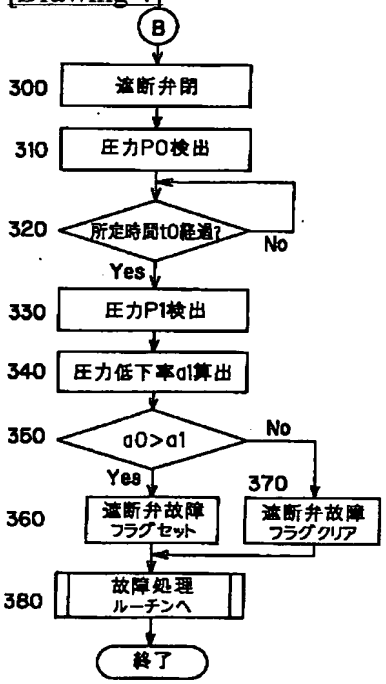

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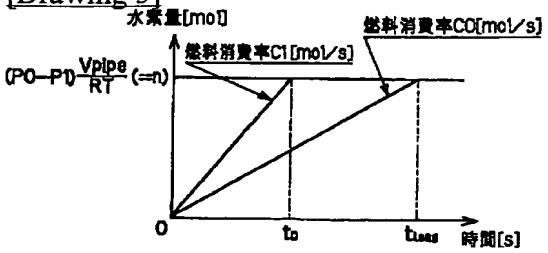

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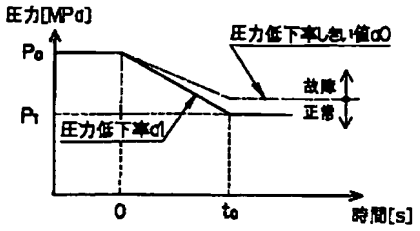

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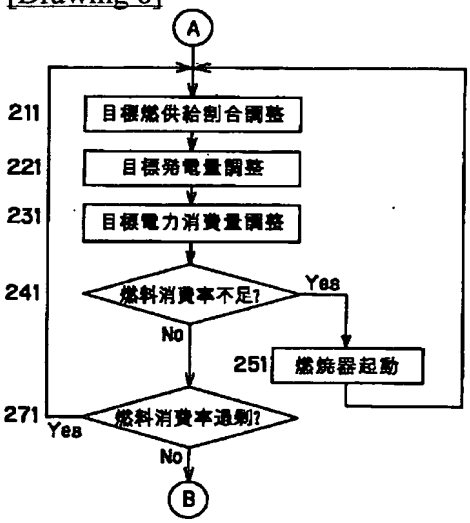
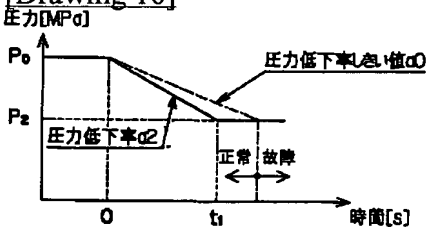


[Drawing 10]



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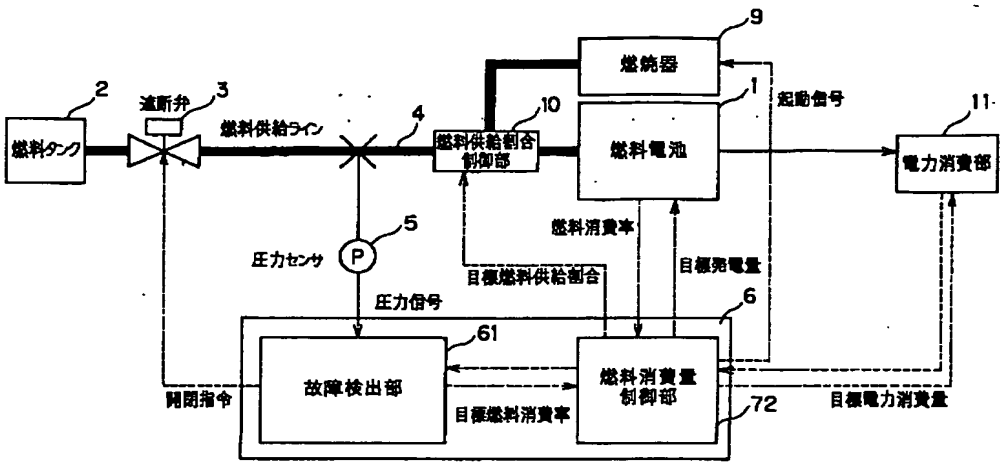

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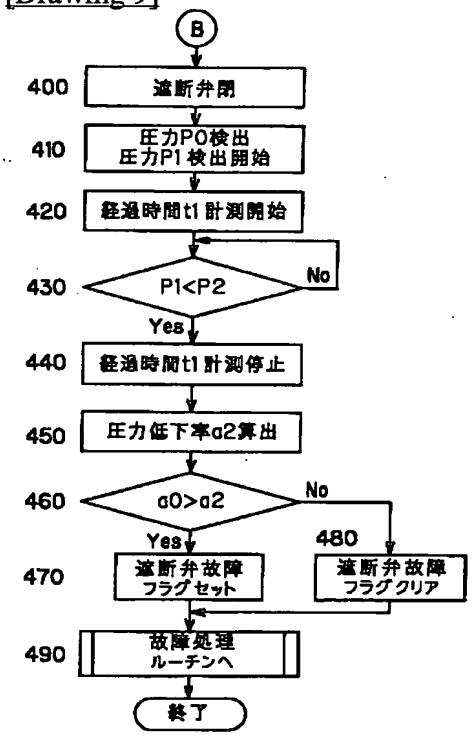

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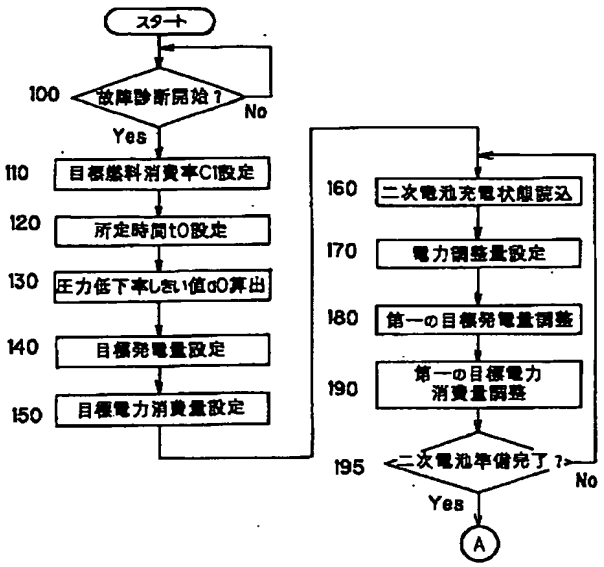
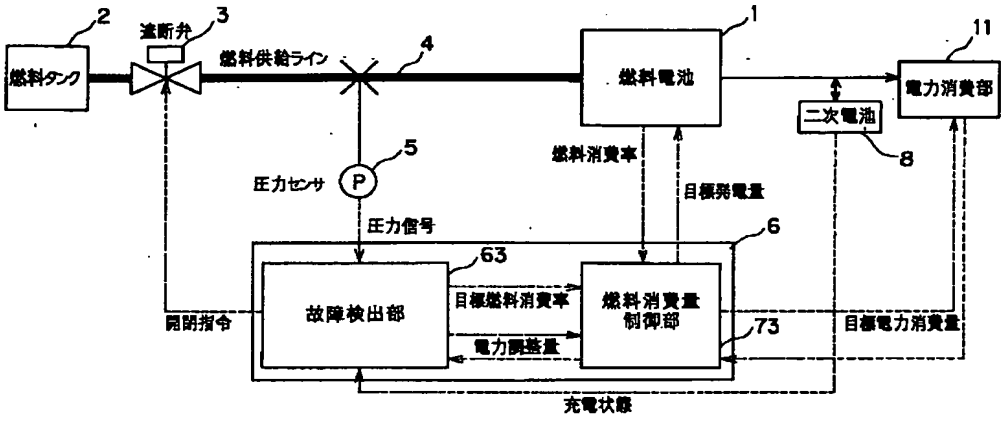
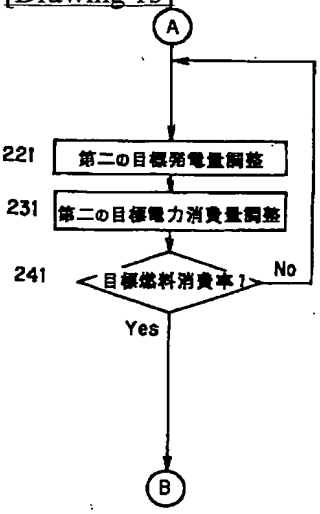


[Drawing 11]



[Drawing 13]



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(71)出願人　000003997
日産自動車株式会社
神奈川県横浜市神奈川区宝町2番地

(72)発明者　猪野　崇
神奈川県横浜市神奈川区宝町2番地　日産自動車株式会社内

(72)発明者　村本　逸朗
神奈川県横浜市神奈川区宝町2番地　日産自動車株式会社内

(74)代理人　100075513
弁理士　後藤　政喜　（外1名）

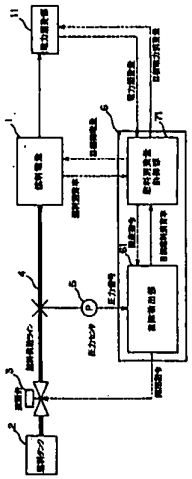
最終頁に続く

(54)【発明の名称】ガス燃料供給装置

(57)【要約】

【課題】　遮断弁の故障診断を短時間に実施可能なガス燃料供給装置を提供する。

【解決手段】　遮断弁３と圧力センサ５をこの順に有する燃料供給ライン４により燃料タンク２から燃料電池１に燃料を供給し、故障診断信号に基づいて遮断弁３を閉弁し、圧力センサ５からの圧力情報と経過時間とに基づいて圧力低下率を算出して遮断弁３の故障状態を判定する場合において、燃料電池１の発電電力を電力消費部１１により消費して目標燃料消費率Ｃ１を増加させ、短時間での故障状態の判定を可能とした。



【特許請求の範囲】

【請求項１】　燃料供給手段から燃料を燃料消費手段に供給し、遮断弁と圧力センサを有する燃料供給ラインと、故障診断信号に基づいて前記遮断弁を閉弁し、少なくとも前記圧力センサからの圧力情報と経過時間とに基づいて圧力低下率を算出し、前記圧力低下率が予め定めた圧力低下率しきい値より小さいときに、前記遮断弁が故障状態であると判断する故障検出手段を有するガス燃料供給装置において、

前記故障診断信号に基づいて前記故障検出手段が作動する条件下では、前記燃料消費手段が消費する目標燃料消費率を増大化して制御する燃料消費量制御手段を備えることを特徴とするガス燃料供給装置。

【請求項２】　前記燃料消費手段に加え、遮断弁の故障診断の実行時に消費した燃料によって得られるエネルギーを蓄えるエネルギー保存手段を備えることを特徴とする請求項１に記載のガス燃料供給装置。

【請求項３】　前記エネルギー保存手段は、遮断弁の故障診断前にエネルギー保存量を調節することを特徴とする請求項２に記載のガス燃料供給装置。

【請求項４】　前記燃料供給手段は、水素リッチなガス燃料を貯留する水素タンクであり、前記燃料消費手段は、燃料電池であり、前記エネルギー保存手段は、電力貯蔵手段であることを特徴とする請求項１ないし請求項３のいずれか一つに記載のガス燃料供給装置。

【請求項５】　前記故障検出手段は、診断に要する水素量から算出される発電電力に応じて前記電力貯蔵手段の充電状態を調節することを特徴とする請求項４に記載のガス燃料供給装置。

【請求項６】　前記燃料消費手段は、補助燃料消費手段を並列に備え、

前記燃料供給ラインは、前記燃料消費手段と前記補助燃料消費手段に燃料を供給する割合を制御する燃料供給割合制御手段を備えることを特徴とする請求項１に記載のガス燃料供給装置

【請求項７】　前記補助燃料消費手段は、燃焼器で構成していることを特徴とする請求項６に記載のガス燃料供給装置

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、遮断弁の故障状態を診断可能なガス燃料供給装置に関するものである。

【０００２】

【従来の技術】従来から遮断弁の故障状態を診断するため、燃料タンクとエンジン等の燃料消費装置との間の配管に遮断弁と圧力センサをこの順に配置し、遮断弁を閉弁して所定時間後の圧力により遮断弁の故障診断を行うものが知られており、例えば、特開２０００－２７４１１号公報に記載されている。

【０００３】これは、車両の停止もしくは運転中に、遮断弁を閉弁し、所定時間後の圧力低下量、あるいは圧力が所定の圧力まで低下するまでの経過時間を計測し、圧力低下率を算出し、圧力低下率しきい値と比較して遮断弁の故障診断を行うものである。

【０００４】

【発明が解決しようとする課題】ところで、遮断弁下流の圧力の低下速度は、車両の運転状態、即ち、燃料消費装置の燃料消費率によって変化する。

【０００５】しかしながら、上記従来例では、遮断弁を閉弁し、所定時間後の圧力低下量、若しくは、圧力が所定圧力まで低下するのに経過する時間を計測して遮断弁の故障診断を行っている。このため、車両の運転状態によって燃料消費率が低い場合には、圧力の低下に時間がかかるものであった。

【０００６】所定時間後の圧力低下量によって診断を行う場合、圧力センサの検出精度や分解能より下限圧力低下量が決定され、設定する所定時間はその下限圧力低下量だけ圧力が低下する時間以上にしなくてはならないため、故障診断を行うのに時間がかかってしまうという問題点がある。

【０００７】また、所定圧力まで低下するのに経過する時間を計測する場合、所定圧力は燃料タンク圧力から前述の下限圧力低下量を引いた値以下にしなければならないため、燃料消費率が低い場合は所定圧力まで圧力が低下するのに時間がかかり故障診断を行うのに時間がかかってしまうという問題点がある。

【０００８】そこで本発明は、上記問題点に鑑みてなされたもので、遮断弁の故障診断を短時間に実施可能なガス燃料供給装置を提供することを目的とする。

【０００９】

【課題を解決するための手段】第１の発明は、燃料供給手段から燃料を燃料消費手段に供給し、遮断弁と圧力センサを有する燃料供給ラインと、故障診断信号に基づいて前記遮断弁を閉弁し、少なくとも前記圧力センサからの圧力情報と経過時間とに基づいて圧力低下率を算出し、前記圧力低下率が予め定めた圧力低下率しきい値より小さいときに、前記遮断弁が故障状態であると判断する故障検出手段を有するガス燃料供給装置において、前記故障診断信号に基づいて前記故障検出手段が作動する条件下では、前記燃料消費手段が消費する目標燃料消費率を増大化して制御する燃料消費量制御手段を備えることを特徴とする。

【００１０】前記燃料消費手段は、燃料電池自動車では燃料ガスを消費する燃料電池や燃料ガスを燃焼する燃焼器であり、前記燃料消費量制御手段は、これらの燃料電池や燃焼器の目標燃料消費率を故障検出手段が作動する条件下では増大化して制御する。

【００１１】第２の発明は、第１の発明において、前記燃料消費手段に加え、遮断弁の故障診断の実行時に消費した燃料によって得られるエネルギーを蓄えるエネルギ

一保存手段を備えることを特徴とする。

【００１２】第３の発明は、第２の発明において、前記エネルギー保存手段は、遮断弁の故障診断前にエネルギー保存量を調節することを特徴とする。

【００１３】第４の発明は、第１ないし第３の発明において、前記燃料供給手段は、水素リッチなガス燃料を貯留する水素タンクであり、前記燃料消費手段は、燃料電池であり、前記エネルギー保存手段は、電力貯蔵手段であることを特徴とする。

【００１４】第５の発明は、第４の発明において、前記故障検出手段は、診断に要する水素量から算出される発電電力に応じて前記電力貯蔵手段の充電状態を調節することを特徴とする。

【００１５】第６の発明は、第１の発明において、前記燃料消費手段は、補助燃料消費手段を並列に備え、前記燃料供給ラインは、前記燃料消費手段と前記補助燃料消費手段に燃料を供給する割合を制御する燃料供給割合制御手段を備えることを特徴とする。

【００１６】第７の発明は、第６の発明において、前記補助燃料消費手段は、燃焼器で構成していることを特徴とする。

【００１７】

【発明の効果】したがって、第１の発明では、故障検出手段は燃料消費手段の燃料消費量を増大化して制御できるので、遮断弁の故障診断をする際に、燃料消費手段の燃料消費量を調節することにより、より短時間で燃料供給ラインの圧力を下げることができ、より短時間に遮断弁の故障診断を行うことができる。

【００１８】第２の発明では、第１の発明の効果に加えて、遮断弁の故障診断のために余分に得られるエネルギーをエネルギー保存手段に溜えるので、燃料を無駄にせずに故障診断をより短い時間で行うことができる。

【００１９】第３の発明では、第２の発明の効果に加えて、遮断弁の故障診断前に前記エネルギー保存手段の保存量を調節するため、故障診断によって得られるエネルギーに応じてエネルギー保存手段の保存量を下げておき、エネルギー保存手段に故障診断によって得られる余分なエネルギーを溜えることができ、エネルギーを無駄に捨てることなく故障診断ができる。

【００２０】第４の発明では、第１ないし第３の発明の効果に加えて、遮断弁の故障診断時に水素ガス燃料を消費する燃料電池の発電電力は電力貯蔵手段に保存されるので、水素を無駄にすることなく遮断弁の故障診断を行うことができる。

【００２１】第５の発明では、第４の発明の効果に加えて、診断に要する水素量から算出される発電電力に応じて前記電力貯蔵手段の充電状態を調節するため、故障診断によって発電した電力を無駄にすることなく電力貯蔵手段に充電することができる。

【００２２】第６の発明では、第１の発明の効果に加えて、燃料供給割合制御手段が目標燃料消費率と燃料消費手段の燃料消費率に応じて燃料消費手段と補助燃料消費手段に燃料を供給する割合を制御するので、燃料消費手段の燃料消費率が目標燃料消費率に対して十分でないとき、補助燃料消費手段に燃料を供給することによって目標燃料消費率で燃料を消費することができる。

【００２３】第７の発明には、第６の発明の効果に加えて、補助燃料消費手段を燃焼器により構成したため、燃料消費手段が十分にガス燃料を消費できないときでも、燃料供給割合制御手段により燃焼器がガス燃料を消費するので、燃料消費手段が十分に水素を消費できないときでも目標燃料消費率で燃料を消費することができる。

【００２４】

【発明の実施の形態】以下、本発明におけるガス燃料供給装置を実現する実施の形態を、請求項１に対応する第１の実施形態に基づいて説明する。

【００２５】（第１の実施形態）図１～図４は、本発明の第１の実施形態に係わるガス燃料供給装置の一例を示し、図１はシステム構成図、図２～図４は故障診断の制御フローチャートを示す。なお、以下に説明する燃料電池およびガス燃料供給装置は、燃料電池自動車等の移動体に搭載される装置である。

【００２６】図１において、ガス燃料供給装置は、主として、水素吸蔵合金が充填されている燃料供給手段としての燃料タンク２と、燃料タンク２よりのガス燃料と酸化剤ガスの供給を受けて電気化学的な反応により電力を発生する燃料消費手段としての燃料電池１と、燃料電池１の電力が供給されるモータ・インバータ等の電力消費部１１と、燃料電池１を安全且つ効率的に運転すること等を目的とするコントローラ６とを備える。

【００２７】前記燃料タンク２は、水素吸蔵合金に吸蔵させた水素をガス燃料として貯蔵する。燃料タンク２よりのガス燃料は、逆流防止機能付きの遮断弁３および配管からなる燃料供給ライン４を経由して燃料電池１に供給可能であり、遮断弁３の開閉により供給量を制御する。

【００２８】コントローラ６は、燃料消費量制御手段としての燃料消費量制御部７１および故障検出手段としての故障検出部６１を備える。燃料消費量制御部７１は、燃料電池１の通常運転時には電力消費部１１に消費される電力消費量に基づいて燃料電池１の目標発電量を算定して燃料電池１の燃料消費率を演算し、必要な遮断弁３のバルブ開度（全開または全閉）を故障検出部６１に出力して遮断弁３を開閉操作する。燃料消費量制御部７１は、また、故障診断時には故障検出部６１より規定される目標燃料消費率Ｃｉと燃料電池１から入力される燃料電池１の燃料消費率から、目標発電量を算出して燃料電池１に出力し、電力消費部１１へ目標電力消費量を出力する。

【００２９】故障検出部６１には、遮断弁３よりも下流

の燃料供給ライン４の配管内の圧力を検出する圧力センサ５よりの圧力信号が入力されている。故障検出部６１は、燃料電池１の通常運転時には、前記燃料消費量制御部７１よりの開度信号に応じて遮断弁３を開閉制御する。なお、燃料電池の通常運転時には、図示しないレギュレータ弁により供給量を連続的（リニア）に制御される。故障検出部６１は、また、故障診断時には、目標燃料消費量Ｃｉ、所定時間ｔ０、圧力低下しきい値ａ０を算出設定し、燃料消費量制御部７１に出力して燃料電池１および電力消費部１１の作動が目標燃料消費量Ｃｉとなるよう制御させる。また、遮断弁３を閉じ、閉弁後の圧力センサ５よりの圧力信号により遮断弁３の故障を判定する。

【００３０】次に第１実施態様の故障診断の詳細な手順を、図２～図４のフローチャートに基づいて説明する。図２に示すステップ１００～１５０は故障診断の条件設定を、図３に示すステップ２２０～２４０は燃料消費量制御部７１の作動を、図４に示すステップ３００～３８０は故障診断の作動を、夫々示している。

【００３１】故障診断の条件設定は、先ず、ステップ１００で、故障検出部６１に対し故障診断信号が出されたか否かを判断する。出されていなければステップ１００に戻り、故障診断信号が出されるまで待つ。故障診断信号が出されていればステップ１１０へ進む。

【００３２】ステップ１１０では、目標燃料消費率Ｃｉを設定しステップ１２０へ進む。目標燃料消費率Ｃｉは、図５に示すように、従来の燃料電池１の燃料消費率をＣ０とすると、規定の水素量ｎを消費するために経過する時間はｔｌｏｎｇとなる。本発明では水素量ｎを消費するための時間がより短くなるように燃料消費率をＣ０よりも大きい目標燃料消費率Ｃｉに設定することによってｔｌｏｎｇよりも短い時間ｔ０で規定の水素量ｎを消費することができる。よって目標燃料消費率はＣｉに設定する。

【００３３】規定の水素量ｎは、圧力センサ５の検出値がＰ０からＰｉになるために消費しなくてはならない水素量である。即ち、遮断弁３から燃料電池１までの燃料供給ライン４の容積をＶｐｉｐｅとし、Ｒを気体定数、Ｔをガス燃料の絶対温度、ｎ０を圧力が初期圧力Ｐ０のときの水素量、ｎｉを圧力がＰｉのときの水素量とすると、

Ｐ０・Ｖｐｉｐｅ＝ｎ０・Ｒ・Ｔ

Ｐｉ・Ｖｐｉｐｅ＝ｎｉ・Ｒ・Ｔ

となるので、消費しなくてはならない水素量ｎは、

ｎ＝ｎ０－ｎｉ＝（１－Ｐｉ／Ｐ０）ｎ０

＝（１－Ｐｉ／Ｐ０）Ｐ０・Ｖｐｉｐｅ／（Ｒ・Ｔ）

＝（Ｐ０－Ｐｉ）Ｖｐｉｐｅ／（Ｒ・Ｔ）

となる。

【００３４】ここで、圧力低下量（Ｐ０－Ｐｉ）＝ΔＰは、圧力センサ５の検出範囲と分解能より、圧力センサ５で十分に識別可能である圧力差ΔＰが決定されるので、圧力低下量（Ｐ０－Ｐｉ）は、圧力差ΔＰ以上に設定すればよい。

【００３５】ステップ１２０では、所定時間ｔ０を設定しステップ１３０へ進む。所定時間ｔ０は、目標燃料消費率Ｃｉで前記水素量ｎを消費したときの消費時間に相当する。即ち、燃料消費率Ｃｉを決定すると、燃料消費率Ｃｉで消費される水素量が（Ｐ０－Ｐｉ）Ｖｐｉｐｅ／（Ｒ・Ｔ）となる時間となる。図６は、遮断弁３が閉じた時点よりの圧力センサ５から検出される圧力と時間の関係を示したものである。時点０のときに遮断弁３に閉指令を出力し、予め定められた所定時間ｔ０が経過するまでの圧力低下量（Ｐ０－Ｐｉ）から圧力低下率ａｉを算出する。

【００３６】ステップ１３０では、圧力低下率しきい値ａ０を設定しステップ１４０へ進む。圧力低下率しきい値ａ０は、目標燃料消費率Ｃｉより、遮断弁３が完全に閉じたときの理論圧力低下率が算出でき、遮断弁３が故障していないと判断可能である圧力低下率の幅を考慮して圧力低下率しきい値ａ０を算出する。なお、故障している遮断弁３を用いて実験をし、故障時の圧力低下率を測定して圧力低下率しきい値ａ０を算出してもよい。このようにして、故障検出部６１は前述の目標燃料消費率Ｃｉを算出し、燃料消費量制御部７１に出力する。

【００３７】ステップ１４０では、燃料消費量制御部７１により目標発電量を設定しステップ１５０へ進む。目標発電量は、故障検出手段６１から入力される目標燃料消費率Ｃｉと燃料電池１から入力される燃料電池１の燃料消費率から算出される。

【００３８】ステップ１５０では、燃料電池１で発生される発電量を電力消費部１１で消費させる目標電力消費量を設定し、図３の燃料消費量制御部７１のフローチャートのステップ２２０へ進む。

【００３９】燃料消費量制御部７１の作動を開始するステップ２２０では、目標燃料消費率Ｃｉで燃料電池１が水素を消費するように目標発電量を調整して燃料電池１へ出力し、ステップ２３０へ進む。

【００４０】ステップ２３０では、燃料電池１が発電した電力を電力消費部１１で消費するために目標電力消費量を調整し、燃料消費量制御部７１から電力消費部１１に目標電力消費量を出力し、ステップ２４０へ進む。

【００４１】ステップ２４０では、燃料電池１の燃料消費率と目標燃料消費率Ｃｉの差が所定の範囲内であるかを判断する。範囲内であれば図４の故障診断作動のフローチャートのステップ３００に進む。範囲外であればステップ２２０～２３０を繰り返して燃料電池１の燃料消費率と目標燃料消費率Ｃｉの差が所定の範囲内となるよう調整する。

【００４２】図４の故障診断作動を開始するステップ３００では、故障検出部６１が遮断弁３に閉指令を出し、

ステップ３１０へ進む。図６では、時点０である。

【００４３】ステップ３１０では、燃料供給ライン４の遮断弁３下流のガス燃料圧力Ｐ０を圧力センサ５より検出し、ステップ３２０へ進む。

【００４４】ステップ３２０では、遮断弁３に閉指令が出されてから、所定時間ｔ０が経過したか否かを判断する。経過していたらステップ３３０へ進み、経過していなければ所定時間ｔ０が経過するまで待つ。図６の時点ｔ０参照。

【００４５】ステップ３３０では、所定時間ｔ０が経過した後の遮断弁３下流の燃料供給ライン４のガス燃料圧力Ｐｉを圧力センサ５より検出し、ステップ３４０へ進む。

【００４６】ステップ３４０では、（Ｐ０－Ｐｉ）／ｔ０により圧力低下率ａｉを算出し、ステップ３５０へ進む。

【００４７】ステップ３５０では、ステップ３４０で算出された圧力低下率ａｉが予め定められた圧力低下率しきい値ａ０よりも小さいか否かを判断する。小さければステップ３６０へ進み、小さくなければステップ３７０へ進む。

【００４８】ステップ３６０では圧力低下率ａｉが圧力低下率しきい値ａ０よりも小さかったので、遮断弁３がガス燃料を完全に遮断せずにガス燃料を燃料電池１に供給してしまっていると判断し遮断弁故障フラグをセットし、ステップ３８０へ進む。

【００４９】ステップ３７０では、圧力低下率ａｉが圧力低下率しきい値ａ０よりも小さくないので遮断弁３はガス燃料を遮断していると判断し、遮断弁故障フラグをクリアし、ステップ３８０へ進む。

【００５０】ステップ３８０では、図示しない故障処理ルーチンへ進む。遮断弁故障フラグがセットされている場合はシステムを停止しドライバーに故障していることを報知するなどの故障処理を行い、次へ進み終了する。

【００５１】このように処理することで遮断弁３の故障診断をより短い時間で行うことが可能となる。

【００５２】なお、診断時間ｔ０を短くするためには、Ｐｉは Ｐ０に近づけてより大きくしたいので、Ｐｉは Ｐ０－ΔＰに設定することが望ましい。

【００５３】本実施の形態にあっては、燃料消費量制御手段としての燃料消費量制御部７１は、故障検出手段としての故障検出部６１により算出される目標燃料消費率Ｃｉで燃料を消費するよう燃料消費手段１１を制御するため、遮断弁３の故障診断をする際に、燃料消費手段としての燃料電池１の燃料消費量を調節することにより、より短時間で燃料供給ライン４の圧力を下げることができ、より短時間に遮断弁３の故障診断を行うことができる。

【００５４】（第２実施形態）以下、本発明におけるガス燃料供給装置を実現する実施の形態を、請求項６、７に対応する第２の実施形態に基づいて説明する。

【００５５】図７～図９は、本発明の第２の実施形態に係わるガス燃料供給装置の一例を示し、第１の実施形態とは、ガス燃料による燃焼器と燃料電池へ供給するガス燃料を分岐して燃焼器へ供給する燃料供給割合制御部とを備えている構成で相違している。図７はシステム構成図、図２、図８、９は故障診断の制御フローチャートである。

【００５６】図７において、９はガス燃料を燃焼させる燃焼器を示し、燃料供給ライン４からの燃料電池１へのガス燃料を燃料供給割合制御部１０により分流して供給される。燃焼器９は燃料消費率制御部７２からの起動信号により起動される。燃料供給ライン４は燃料タンク２と燃料電池１の間に遮断弁３と圧力センサ５と燃料供給割合制御部１０がこの順で設けてある。燃料供給割合制御部１０は、燃料消費量制御部７２から入力される目標燃料供給割合指令に応じて燃料電池１と燃焼器９に供給するガス燃料の割合を調節する。即ち、燃料消費量制御部７２は燃料供給割合制御部１０に目標燃料供給割合指令を出力し、燃料電池１に目標発電量指令を出力し、燃焼器に起動信号を出力し、電力消費部１１に目標電力消費量を出力する。

【００５７】次に第２実施態様の故障診断の詳細な手順を、図２、図８、９のフローチャートに基づいて説明する。図２に示すステップ１００～１５０は故障診断の条件設定を、図８に示すステップ２１１～２７１は燃料消費量制御部７２の作動を、図９に示すステップ４００～４９０は故障診断の作動を、夫々示している。

【００５８】図２に示すステップ１００～１５０は故障診断の条件設定は、既に説明しており、図８に示す燃料消費量制御部７２の作動をステップ２１１～２７１の順を追って説明する。

【００５９】燃料消費量制御部７２の作動のステップ２１１では、目標燃料供給割合を調整してステップ２２１へ進む。目標燃料供給割合の初期値は、燃料電池１に１００％、燃焼器に０％となっている。ステップ２５１を経由してステップ２１１へ到達した場合には、燃料消費量が目標燃料消費量に一致するように目標燃料供給割合を調整する。調整量はあらかじめ実験などにより燃料消費量と目標燃料供給割合の関係をマップ化しておき、算出する。

【００６０】ステップ２２１では、目標燃料消費率Ｃｉで燃料電池１が水素を消費するように目標発電量を調整しステップ２３１へ進む。燃焼器９が起動している場合は、目標燃料消費率Ｃｉと燃料電池１に供給される水素量に応じて目標発電量を調整する。

【００６１】ステップ２３１では、燃料電池１が発電した電力を電力消費部１１で消費するために電力消費部１１での目標電力消費量を調整しステップ２４１へ進む。燃焼器９が起動している場合は、燃料電池１に供給される水素量に応じて目標電力消費量を調整する。

【００６２】ステップ２４１では、燃料電池１の燃料消費率が目標燃料消費率Ｃｉよりも小さいか否かを判断する。小さければステップ２５１に進み、小さくなければステップ２７１へ進む。

【００６３】ステップ２７１では、燃料電池１の燃料消費率が目標燃料消費率Ｃｉよりも大きいか否かを判断する。大きければステップ２２１に進み、大きくなければＢを経由して図９に示す故障診断の作動であるステップ４００へ進む。

【００６４】ステップ２５１では、燃焼器９に起動信号を出力してステップ２１１に進む。

【００６５】ステップ2.4１とステップ２７１の判断は、分岐条件に適切な範囲をもたせて判断を行う。具体的には、燃料消費率Ｃと目標燃料消費率Ｃｉを比較する際、適切な範囲ΔＣ＞０を設定し、ステップ２４１では、（Ｃｉ＜Ｃ＋ΔＣ）が成立すればステップ２７１へ進み、ステップ２７１では、（Ｃｉ＞Ｃ－ΔＣ）が成立すれば、図９に示す故障診断の作動であるステップ４００へ進む。

【００６６】図９に示す故障診断の作動においては、図４の故障診断の作動が、所定時間ｔ０が経過したときの圧力低下量を計測して遮断弁３の故障診断をするのに対し、圧力センサ５から検出される圧力が所定圧力Ｐ２まで低下する経過時間ｔｉを計測して遮断弁３の故障診断を行うものである。

【００６７】図１０により、故障診断方法の詳細を説明する。図１０の太線は圧力センサ５から検出される圧力と時間の関係を示した図である。時点０で遮断弁３に閉指令を出し、圧力センサ５の検出値が予め定められた所定圧力Ｐ２になるまでの経過時間ｔｉを計測する。前述の圧力低下率しきい値ａ０によって圧力がＰ０から所定圧力Ｐ２になるまでの時間と経過時間ｔｉを比較することによって遮断弁３の故障診断を行うものである。

【００６８】図９に戻り、故障診断の作動をフローチャートに基づいて説明する。

【００６９】ステップ４００では、遮断弁３に故障検出部６１が閉指令を出力する。

【００７０】ステップ４１０では、遮断弁３下流の燃料供給ライン４のガス燃料圧力Ｐ０を検出し、時々刻々と圧力センサ５より検出するガス燃料圧力Ｐｉの計測を開始する。

【００７１】ステップ４２０では、遮断弁３に閉指令を出力してからの経過時間ｔｉの計測を開始する。

【００７２】ステップ４３０では、圧力センサ５より時々刻々と検出されるガス燃料圧力Ｐｉが予め定められた診断停止圧力Ｐ２より小さいか否か判断する。小さければステップ４４０に進み、小さくなければステップ４３０に進む。診断停止圧力Ｐ２は圧力センサ５で十分に識別可能である範囲でより大きな値としたほうが、診断にかかる時間が少なくなり、より効果的である。よって遮断弁３下流のガス燃料圧力Ｐ０と圧力センサ５の分解能や検出範囲から診断停止圧力Ｐ２が設定される。

【００７３】ステップ４４０では、遮断弁３に閉指令を出力してから、圧力センサ５より時々刻々と検出されるガス燃料圧力Ｐｉが診断停止圧力Ｐ２を下回るまでの経過時間ｔｉの計測を停止する。

【００７４】ステップ４５０では、（Ｐ０－Ｐ２）／ｔｉより圧力低下率ａ２を算出する。

【００７５】ステップ４６０では、ステップ４５０で算出された圧力低下率ａ２が予め定められた圧力低下率しきい値ａ０よりも小さいか否か判断する。小さければステップ４７０に進み、小さくなければステップ４８０に進む。

【００７６】ステップ４７０では、圧力低下率ａ２が圧力低下率しきい値ａ０よりも小さかったので、遮断弁３がガス燃料を遮断せずにガス燃料を燃料電池１側に供給してしまっていると判断し遮断弁故障フラグをセットする。

【００７７】ステップ４８０では、圧力低下率ａ２が圧力低下率しきい値ａ０よりも小さくないので遮断弁３はガス燃料を遮断していると判断し遮断弁故障フラグをクリアする。

【００７８】ステップ４９０では、図示しない故障処理ルーチンへ進む。遮断弁故障フラグがセットされている場合はシステムを停止しドライバーに故障していることを報知するなどの故障処理を行い、次へ進み終了する。

【００７９】このように処理することで、燃料電池１が目標燃料消費率Ｃｉで燃料を消費できなくても燃焼器９を用いることにより目標燃料消費率Ｃｉで燃料を消費することが可能となり、遮断弁３の故障診断をより短時間で行うことが可能となる。

【００８０】本実施の形態にあっては、第１の実施の形態による効果に加えて、燃料消費手段としての燃料電池１は補助燃料消費手段としての燃焼器９を並列に備え、燃料供給割合制御手段としての燃料供給割合制御部１０が目標燃料消費率Ｃｉと燃料電池１の燃料消費率に応じて燃料電池１と燃焼器９に燃料を供給する割合を制御するので、燃料電池１の燃料消費率が目標燃料消費率Ｃｉに対して十分でないとき、燃焼器９に燃料を供給することによって目標燃料消費率Ｃｉで燃料を消費することができる。

【００８１】また、補助燃料消費手段を燃焼器９により構成したため、燃料電池１が十分にガス燃料を消費できないときでも、燃料供給割合制御部１０により燃焼器９がガス燃料を消費するので、目標燃料消費率Ｃｉで燃料を消費することができる。

【００８２】（第３実施形態）以下、本発明におけるガス燃料供給装置を実現する実施の形態を、請求項２～５に対応する第３の実施形態に基づいて説明する。

【００８３】図１１～図１３は、本発明の第３の実施形態に係わるガス燃料供給装置の一例を示し、第１の実施形態に対して、燃料電池で発電した電力を充電可能な二次電池を付加したものである。図１１はシステム構成図、図１２、１３、および図４は故障診断の制御フローチャートを示す。

【００８４】図１１において、二次電池８は燃料電池１が発電した電力を充電することが可能であり、また、電力消費部１１に放電することが可能である。二次電池８の充電状態は燃料電池１の発電量と電力消費部１１の電力消費量に応じて変化する。

【００８５】故障検出部６３は故障診断信号より故障診断を開始する。故障検出部６３は、遮断弁３を閉じる前に、故障診断によって燃料電池１が余分に発電する電力を二次電池８が充電できる状態となるように電力調整量を算出し燃料消費量制御部７３に出力する。

【００８６】燃料消費量制御部７３は故障検出部６３から目標燃料消費率Ｃｉと電力調整量が入力され、燃料電池１から燃料消費率が入力され、目標発電量と目標電力消費量を算出する。電力調整量が変化すると、目標発電量と目標電力消費量のバランスも変化し二次電池８の充電状態を変化させることができる。

【００８７】次に第２実施態様の故障診断の詳細な手順を、図１２、１３、および、図４のフローチャートに基づいて説明する。図１２に示すステップ１００～１９５は故障診断の条件設定を、図１３に示すステップ２２１～２４１は燃料消費量制御部７３の作動を、図４に示すステップ３００～３８０は故障診断の作動を、夫々示している。

【００８８】図１２に示す故障診断の条件設定のステップ１００～１５０に係わる部分は、故障診断開始信号をステップ１００で検出し、ステップ１１０で目標燃料消費率Ｃｉを設定し、所定時間ｔ０をステップ１２０で設定し、圧力低下率しきい値ａ０をステップ１３０で算出し、目標発電量をステップ１４０で設定し、目標電力消費量Ｃｉをステップ１５０で設定する作動は、図２のステップ１００～１５０と同じである。

【００８９】ステップ１６０では、二次電池８の充電状態を読み込み、ステップ１７０へ進む。

【００９０】ステップ１７０では、電力調整量を次のように設定し、ステップ１８０へ進む。故障診断をするために燃料電池１が消費しなければならない水素量ｎから発電される電力を算出する。算出した電力から燃料電池１を運転するために必要な補器で用いる電力を引く。この電力が二次電池８に充電可能となる目標充電状態を算出する。ステップ１６０で読み込んだ二次電池８の充電状態と、目標充電状態との差を算出し、二次電池８への電力調整量を算出する。

【００９１】ステップ１８０で調整される第一の目標発電量とステップ１９０で調整される第一の目標電力消費量は二次電池８の充電状態が目標充電状態と一致するように調整する。例えば、第一の目標電力消費量は電力の無駄を避けるために必要最低限の値に設定し、第一の目標発電量は二次電池８の充電状態が目標充電状態となる所望の時間を設定し、設定した時間で充電状態が目標充電状態となるように第一の目標発電量を設定すればよい。

【００９２】ステップ１９５では、二次電池８の充電状態が故障診断によって発電される電力を充電できる状態になったか否かを判断する。なっていれば図１３の燃料消費量制御部７３の作動であるステップ２２１へ進み、なっていなければステップ１６０～１９０を再度実行する。

【００９３】図１３の燃料消費量制御部７３の作動であるステップ２２１では目標燃料消費率Ｃｉで燃料電池１が水素を消費するように第二の目標発電量を調整し、ステップ２３１へ進む。

【００９４】ステップ２３１では、燃料電池１が発電した電力を電力消費部１１で消費するために目標電力消費量を調整し、ステップ２４１へ進む。

【００９５】ステップ２４１では、燃料電池１の燃料消費率と目標燃料消費率Ｃｉの差が所定の範囲内であるかを判断する。範囲内であれば故障診断の作動である図４のＢを経由してステップ３００に進む、範囲外であればステップ２２１へと進み、再度ステップ２２１～２４１を実行する。

【００９６】次いで、図４のステップ３００～３８０の故障診断処理（既に、第１実施態様において詳細に説明しており、ここでは、簡略に記載する）を実行し、遮断弁３を閉じ、所定時間ｔ０経過後の燃料供給ライン４のガス燃料圧Ｐｉを検出し、圧力低下率ａｉ（＝（Ｐ０－Ｐｉ）／ｔ０）を算出し、圧力低下しきい値ａ０と比較して遮断弁３を故障診断し、終了する。

【００９７】このように、燃料電池１が発電した電力を電力消費部１１による消費に加えて二次電池８に蓄えるため、遮断弁３の故障診断をより短い時間で行うことが可能となる。しかも、発電された電力を二次電池８に貯えるため、ガス燃料および発電された電力を無駄にすることがなくなる。

【００９８】本実施の形態にあっては、第１の実施の形態による効果に加えて、下記に記載した効果を奏することができる。即ち、遮断弁３の故障診断のために余分に得られるエネルギーをエネルギー保存手段としての二次電池８に蓄えるので、燃料を無駄にせずに故障診断をより短い時間で行うことができる。

【００９９】遮断弁３の故障診断前に前記エネルギー保存手段としての二次電池８の保存量を調節するため、故障診断によって得られるエネルギーに応じて二次電池８の保存量を下げておき、二次電池８に故障診断によって得られる余分なエネルギーを蓄えることができ、エネルギーを無駄に捨てることなく故障診断ができる。

【０１００】なお、上記第１実施形態にあっては、図２（故障診断の条件設定）、図３（燃料消費量制御部の作動）、図４（故障診断作動）とし、第２実施形態にあっては、図２（故障診断の条件設定）、図８（燃料消費量制御部の作動）、図９（故障診断作動）とし、第３実施形態においては、図１２（故障診断の条件設定）、図１３（燃料消費量制御部の作動）、図４（故障診断作動）として、３種類の構成となっている。しかしながら、これらの組合わせは、上記組み合わせに限定されるものでなく、図示しないが、例えば、図１２、図８、図４の組合わせであってもよい。即ち、図２若しくは図１２で開始され、図３、図８、図１３のいずれか一つへ進み、図４若しくは図９で終了される組合わせであれば、どの組み合わせでも遮断弁３の診断をより短い時間で行うことが可能である。

【図面の簡単な説明】

【図１】本発明の一実施形態を示すガス燃料供給装置のシステム構成図。

【図２】故障診断の条件設定の制御フローチャート。

【図３】同じく図２に続く故障診断の燃料消費量制御部の制御フローチャート。

【図４】同じく図３に続く故障診断の作動を示す制御フローチャート。

【図５】目標燃料消費率と消費時間との関係を示すグラフ。

【図６】遮断弁が閉じた時点より所定時間後の圧力低下量測定による故障診断の圧力センサから検出される圧力と時間の関係を示したグラフ。

【図７】本発明の第２の実施形態を示すガス燃料供給装置のシステム構成図。

【図８】図２に続く故障診断の燃料消費量制御部の制御フローチャート。

【図９】同じく図８に続く故障診断の作動を示す制御フローチャート。

【図１０】遮断弁が閉じた時点より所定圧力低下に要した経過時間測定による故障診断の圧力センサから検出される圧力と時間の関係を示したグラフ。

【図１１】本発明の第３の実施形態を示すガス燃料供給装置のシステム構成図。

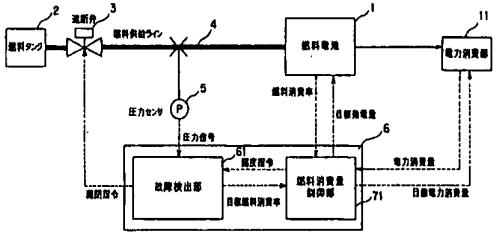
【図１２】故障診断の条件設定の制御フローチャート。

【図１３】図１３に続く故障診断の燃料消費量制御部の制御フローチャート。

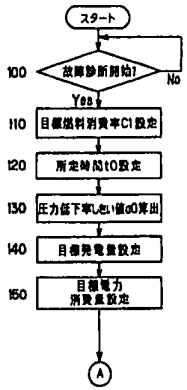
【符号の説明】

１　燃料消費手段としての燃料電池
２　燃料供給手段としての燃料タンク
３　遮断弁
４　燃料供給ライン
５　圧力センサ
６　コントローラ
８　エネルギー保存手段および電力貯蔵手段としての二次電池
９　補助燃料消費手段としての燃焼器
１０　燃料供給割合制御部（燃料供給割合制御手段）
１１　電力消費部
６１、６２　故障検出部（故障検出手段）
７１、７２、７３　燃料消費量制御部（燃料消費量制御手段）

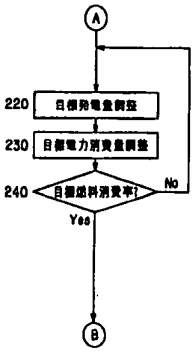
【図１】



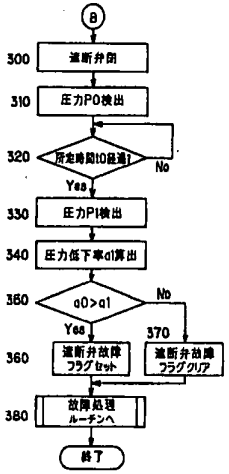
【図２】



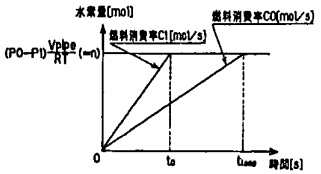
【図３】



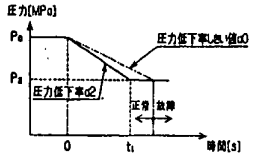
【図４】



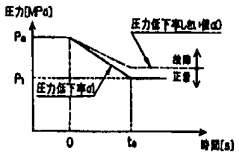
【図５】



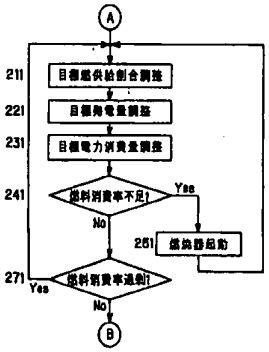
【図１０】



【図６】



【図８】



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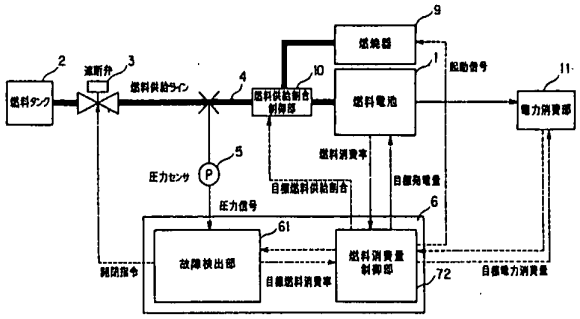

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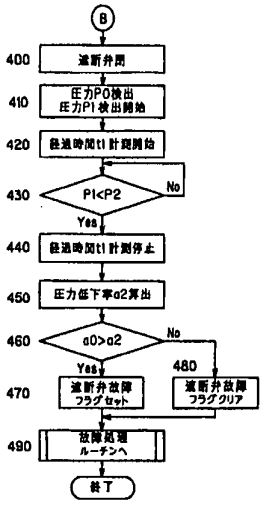
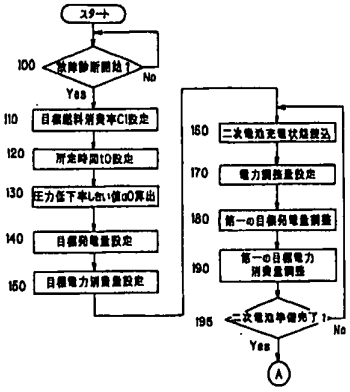
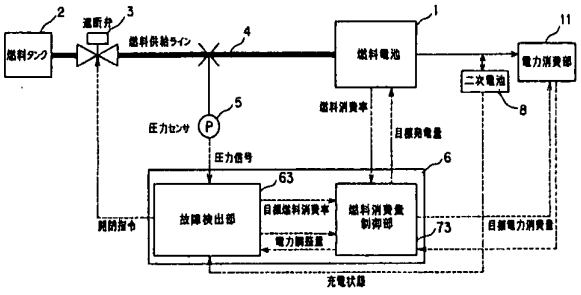


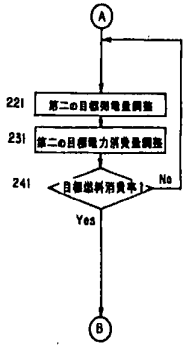
【図１２】



【図１１】



【図１３】



フロントページの続き

(72)発明者　布施　徹
神奈川県横浜市神奈川区宝町２番地　日産
自動車株式会社内

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